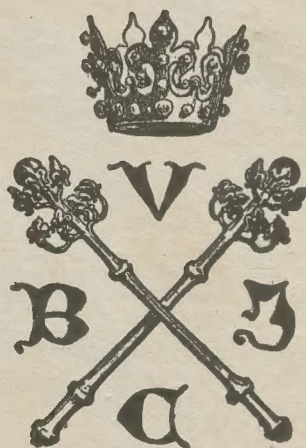




Мас. 51. Др.

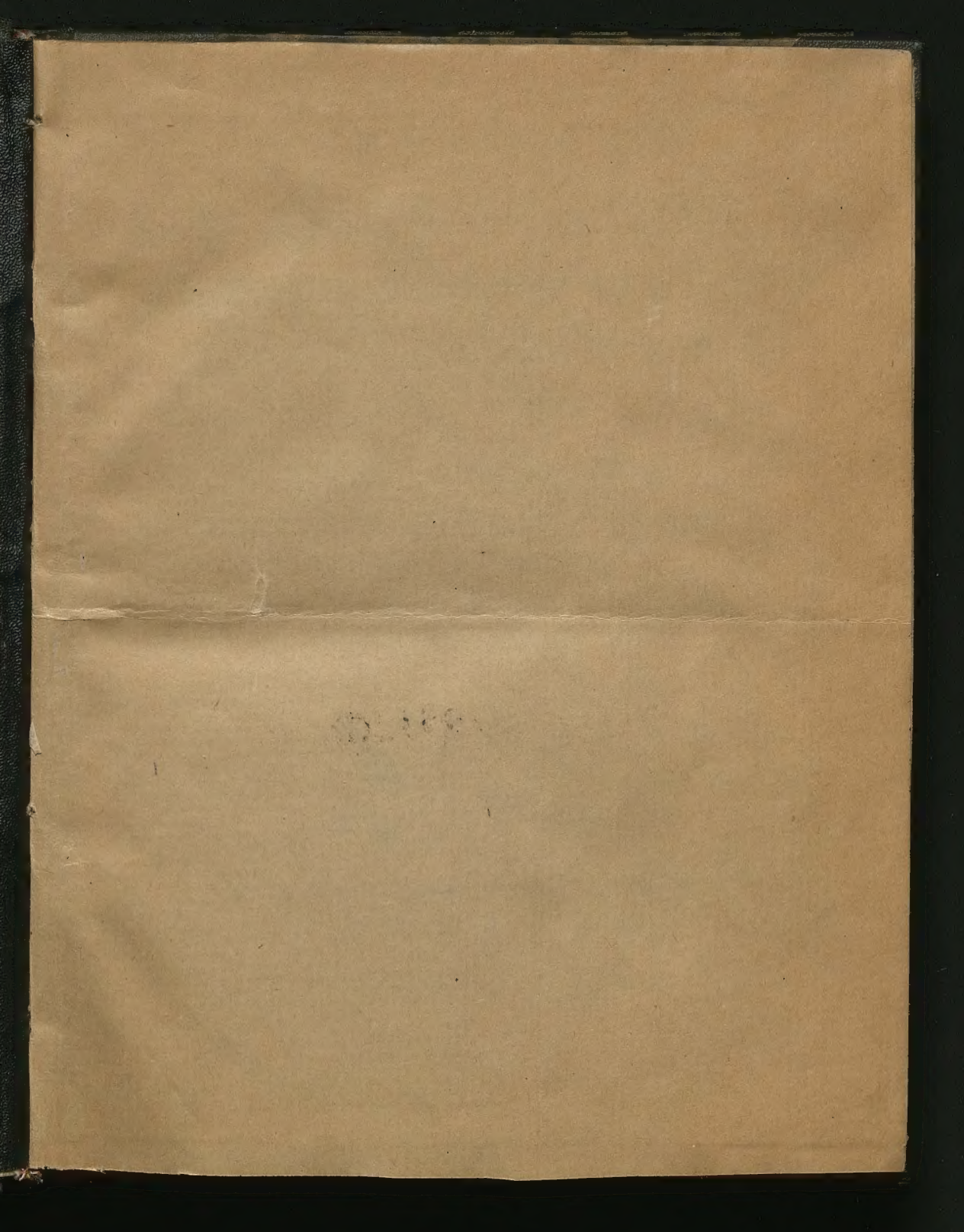
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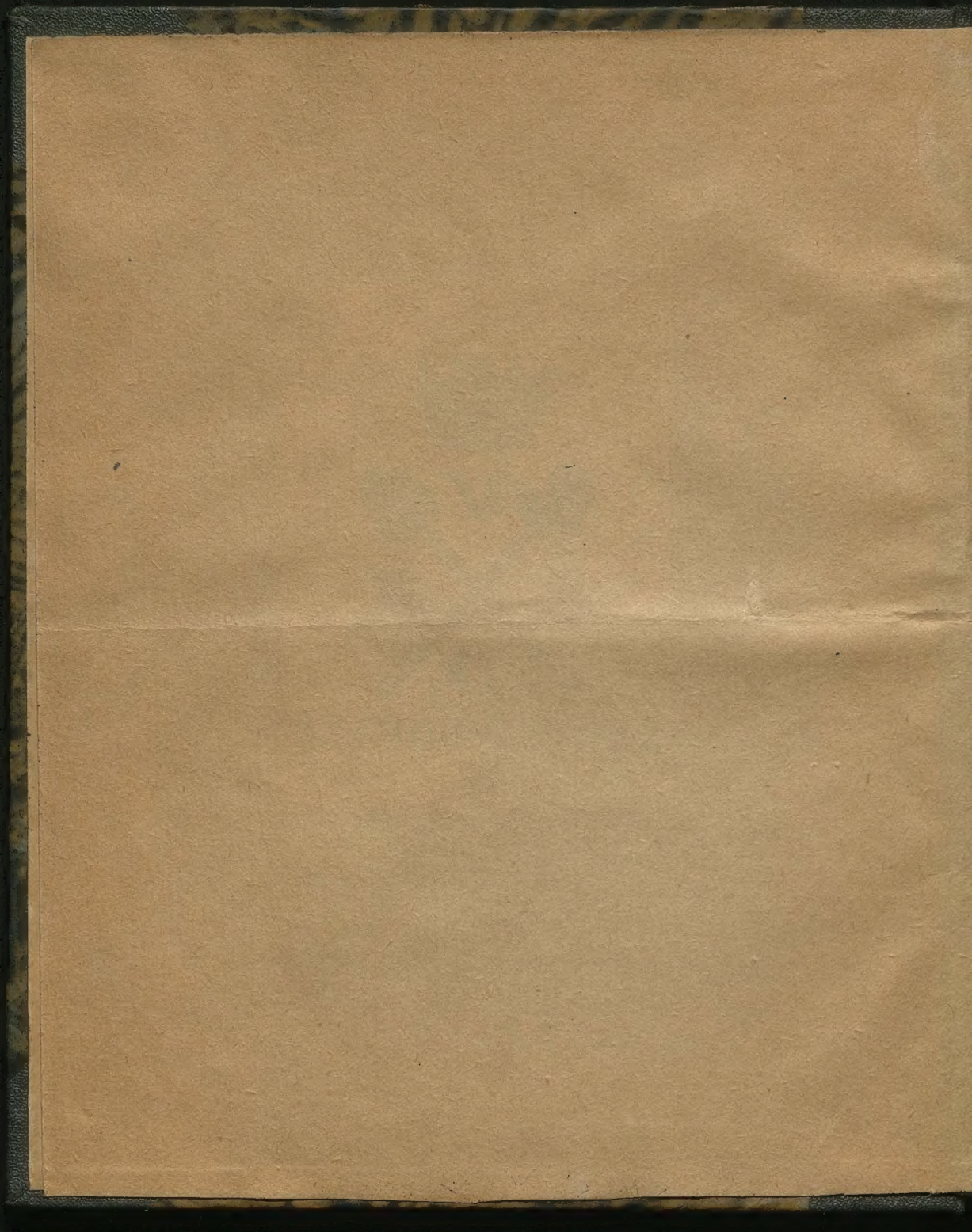
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C O N C L U S I O

CIRCULI QUADRATURÆ

NOVISSIMÆ ET BREVISSIMÆ.

10.

221969

§. 22. **S**cholion. Continuatione Quadraturæ novissimæ & brevissimæ jam impressa, sed nondum publicata, contigit mihi legere manuscriptum quoddam, cujus Autor Anonymus asserit, summam $\frac{0 + m}{mo}$ (§. 3. 13.) innumeris modis posse resolvi in 2 partes,

adeoque non esse necesse, ut unus factor sit denominator unius partis, alter factor denominator alterius, Et unitas numerator utriusque partis. Falsissimum esset, inquit, si diceretur, summam e. gr. $\frac{36}{288} = \frac{24 + 12}{12 \times 24}$

non posse constare ex aliis partibus, quam ex $\frac{1}{24}$ & $\frac{1}{12}$: Constat enim etiam ex partibus $\frac{1}{40}$ & $\frac{1}{10}$ (quoniam $\frac{1}{40} + \frac{1}{10} = \frac{100}{400} + \frac{40}{400} = \frac{140}{400} = \frac{7}{200} = \frac{36}{288}$). Posset aliorum exemplorum magna copia addi.

Ad quod cum venia Cl. Anonymi ita respondeo: Partes $\frac{1}{40}$ & $\frac{1}{10}$ constituunt quidem summam $\frac{140}{400}$ æqualem $\frac{36}{288}$, quia utrobique numerator habet ad denominatorem suum eandem rationem, nempe ut 1: 8; sed nunquam possunt constituere summam eandem $\frac{36}{288}$. Quæ sunt eadem, sunt etiam æqualia; sed non vice versa, quæ sunt æqualia, sunt etiam eadem. Nam etsi Rhomboides cum quadrato eandem basin & æqualem altitudinem habens, sit huic æqualis; absurdum tamen esset inde concludere, quadratum esse Rhomboidem, vel vice versa. Quodlibet par fractionum sequentium: $\frac{1}{2} \& \frac{1}{24}$; $\frac{1}{3} \& \frac{1}{12}$; $\frac{1}{4} \& \frac{1}{12}$; $\frac{1}{5} \& \frac{1}{20}$; $\frac{1}{6} \& \frac{1}{24}$; $\frac{1}{7} \& \frac{1}{28}$; $\frac{1}{8} \& \frac{1}{32}$; $\frac{1}{9} \& \frac{1}{36}$; $\frac{1}{10} \& \frac{1}{40}$; $\frac{1}{11} \& \frac{1}{44}$; $\frac{1}{12} \& \frac{1}{48}$; $\frac{1}{13} \& \frac{1}{52}$; $\frac{1}{14} \& \frac{1}{56}$; $\frac{1}{15} \& \frac{1}{60}$; $\frac{1}{16} \& \frac{1}{64}$; $\frac{1}{17} \& \frac{1}{68}$; $\frac{1}{18} \& \frac{1}{72}$; $\frac{1}{19} \& \frac{1}{76}$; $\frac{1}{20} \& \frac{1}{80}$; $\frac{1}{21} \& \frac{1}{84}$; $\frac{1}{22} \& \frac{1}{88}$; $\frac{1}{23} \& \frac{1}{92}$; $\frac{1}{24} \& \frac{1}{96}$; $\frac{1}{25} \& \frac{1}{100}$; $\frac{1}{26} \& \frac{1}{104}$; $\frac{1}{27} \& \frac{1}{108}$; $\frac{1}{28} \& \frac{1}{112}$; $\frac{1}{29} \& \frac{1}{116}$; $\frac{1}{30} \& \frac{1}{120}$; $\frac{1}{31} \& \frac{1}{124}$; $\frac{1}{32} \& \frac{1}{128}$; $\frac{1}{33} \& \frac{1}{132}$; $\frac{1}{34} \& \frac{1}{136}$; $\frac{1}{35} \& \frac{1}{140}$; $\frac{1}{36} \& \frac{1}{144}$; $\frac{1}{37} \& \frac{1}{148}$; $\frac{1}{38} \& \frac{1}{152}$; $\frac{1}{39} \& \frac{1}{156}$; $\frac{1}{40} \& \frac{1}{160}$; $\frac{1}{41} \& \frac{1}{164}$; $\frac{1}{42} \& \frac{1}{168}$; $\frac{1}{43} \& \frac{1}{172}$; $\frac{1}{44} \& \frac{1}{176}$; $\frac{1}{45} \& \frac{1}{180}$; $\frac{1}{46} \& \frac{1}{184}$; $\frac{1}{47} \& \frac{1}{188}$; $\frac{1}{48} \& \frac{1}{192}$; $\frac{1}{49} \& \frac{1}{196}$; $\frac{1}{50} \& \frac{1}{200}$; $\frac{1}{51} \& \frac{1}{204}$; $\frac{1}{52} \& \frac{1}{208}$; $\frac{1}{53} \& \frac{1}{212}$; $\frac{1}{54} \& \frac{1}{216}$; $\frac{1}{55} \& \frac{1}{220}$; $\frac{1}{56} \& \frac{1}{224}$; $\frac{1}{57} \& \frac{1}{228}$; $\frac{1}{58} \& \frac{1}{232}$; $\frac{1}{59} \& \frac{1}{236}$; $\frac{1}{60} \& \frac{1}{240}$; $\frac{1}{61} \& \frac{1}{244}$; $\frac{1}{62} \& \frac{1}{248}$; $\frac{1}{63} \& \frac{1}{252}$; 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$\frac{1}{390} \& \frac{1}{1560}$; $\frac{1}{391} \& \frac{1}{1564}$; $\frac{1}{392} \& \frac{1}{1568}$; $\frac{1}{393} \& \frac{1}{1572}$; $\frac{1}{394} \& \frac{1}{1576}$; $\frac{1}{395} \& \frac{1}{1580}$; $\frac{1}{396} \& \frac{1}{1584}$; $\frac{1}{397} \& \frac{1}{1588}$; $\frac{1}{398} \& \frac{1}{1592}$; $\frac{1}{399} \& \frac{1}{1596}$; $\frac{1}{400} \& \frac{1}{1600}$; $\frac{1}{401} \& \frac{1}{1604}$; $\frac{1}{402} \& \frac{1}{1608}$; $\frac{1}{403} \& \frac{1}{1612}$; $\frac{1}{404} \& \frac{1}{1616}$; $\frac{1}{405} \& \frac{1}{1620}$; $\frac{1}{406} \& \frac{1}{1624}$; $\frac{1}{407} \& \frac{1}{1628}$; $\frac{1}{408} \& \frac{1}{1632}$; $\frac{1}{409} \& \frac{1}{1636}$; $\frac{1}{410} \& \frac{1}{1640}$; $\frac{1}{411} \& \frac{1}{1644}$; $\frac{1}{412} \& \frac{1}{1648}$; $\frac{1}{413} \& \frac{1}{1652}$; $\frac{1}{414} \& \frac{1}{1656}$; $\frac{1}{415} \& \frac{1}{1660}$; $\frac{1}{416} \& \frac{1}{1664}$; $\frac{1}{417} \& \frac{1}{1668}$; $\frac{1}{418} \& \frac{1}{1672}$; $\frac{1}{419} \& \frac{1}{1676}$; $\frac{1}{420} \& \frac{1}{1680}$; $\frac{1}{421} \& \frac{1}{1684}$; $\frac{1}{422} \& \frac{1}{1688}$; $\frac{1}{423} \& \frac{1}{1692}$; $\frac{1}{424} \& \frac{1}{1696}$; $\frac{1}{425} \& \frac{1}{1700}$; $\frac{1}{426} \& \frac{1}{1704}$; $\frac{1}{427} \& \frac{1}{1708}$; $\frac{1}{428} \& \frac{1}{1712}$; $\frac{1}{429} \& \frac{1}{1716}$; $\frac{1}{430} \& \frac{1}{1720}$; $\frac{1}{431} \& \frac{1}{1724}$; $\frac{1}{432} \& \frac{1}{1728}$; $\frac{1}{433} \& \frac{1}{1732}$; $\frac{1}{434} \& \frac{1}{1736}$; $\frac{1}{435} \& \frac{1}{1740}$; $\frac{1}{436} \& \frac{1}{1744}$; $\frac{1}{437} \& \frac{1}{1748}$; $\frac{1}{438} \& \frac{1}{1752}$; $\frac{1}{439} \& \frac{1}{1756}$; $\frac{1}{440} \& \frac{1}{1760}$;

ex utroque factore denominatoris, nisi $\frac{1}{24}$ & $\frac{1}{12}$. Quod ut evidentius appareat, investigemus lunulam respondentem diametri quadrato $= 1$. Sit itaque hujus ratio ad illam excessiva, ut $4 : 1\frac{1}{2} = 24 : 7$, & defectiva ut $4 : \frac{2}{3} = 12 : 2$; erunt lunulae per utramque inventae $\frac{7}{24}$ & $\frac{2}{12} = \frac{14}{48}$ & $\frac{4}{48}$, quae ex se invicem ablatæ, relinquant summam excessus & defectus $\frac{24}{48}$, cujus numerator est aggregatum ex utroque factore $d + a = 12 + 24$ denominatoris ad $= 24$. $12 = 288$. Quoniam igitur hæc summa est conflata ex excessu & defectu (S. 2.), & per demonstrata nullæ aliæ partes sunt assignabiles, quæ eam ita constituent, ut ejus numerator sit aggregatum ex utroque factore denominatoris nisi $\frac{1}{24}$ & $\frac{1}{12}$; debet harum altera necessario esse excessus, altera defectus. Jam cum lunula excessus sit aggregatum ex vera & excessu; necesse est, ut ejus excessus sit vel $\frac{1}{12}$, vel $\frac{1}{24}$; sed $\frac{1}{12}$ est diversa, $\frac{1}{24}$ autem ejusdem cum ea denominationis: ergo $\frac{1}{24}$ utpote ejus pars homogenea debet necessario esse excessus, & per consequens $\frac{1}{12}$ defectus; nam $\frac{7}{24} - \frac{1}{24} = \frac{6}{24} = \frac{1}{4}$; vel $\frac{2}{12} + \frac{1}{12} = \frac{3}{12} = \frac{1}{4}$ est utique lunula vera; quæ cum tam per rationes $4 : 1\frac{1}{2}$ & $4 : \frac{2}{3}$; $4 : 1\frac{1}{3}$ & $4 : \frac{1}{3}$; $4 : 1\frac{1}{2}$ & $4 : \frac{1}{3}$, quàm per innumeras alias exactissime determinetur; evidens est, problema IV demonstrans 2dam partem Theorematis S. 3tii, esse verò verius: consequenter problema III huic superstructum firmissimo inniti fundamento. Jam cum quantitates incognitæ proportionaliter crescentes (veluti diametri cum peripheriis; quadrata diametrorum cum lunulis, circulis & segmentis; cubi diametrorum cum sphaeris; quadrata linearum constantium cum sectionibus conicis, & quæ alia ejus generis) eadem methodo queant perfectissime determinari; dubitare non licet de usu amplissimo hujus solutionis. Me non monente autem facile intelligetur, nullatenus determinari posse e. gr. fractionem inter $\frac{1}{2}$ & $\frac{1}{3}$ cadentem, quam aliquis in mente habeat, quia limites $\frac{1}{2}$ & $\frac{1}{3}$ per nullam proportionem naturæ quæstionis conformem possunt investigari. Interim ne quid perfectioni hujus opusculi deesse videatur; lubet adhuc adjicere sequentia.

THEOREMA II.

S. 23. Circuli Ludolphinus, Metianus & Archimedeus peccant in excessu: imus $\frac{1200}{32000}$, 2dus $\frac{600}{14400}$, 3tius $\frac{400}{448}$ quadrati diametri.

Demonstratio. Ratio Ludolphina quadrati diametri ad circulum 1000 : 785 multiplicata per 32 prodit $= 32000 : 25120$; assumtis deinde diametri quadrato $= 1$, & ratione defectiva $32 : 24$, producant circuli $\frac{25120}{32000}$ & $\frac{24}{32} = \frac{603840}{1024000}$ & $\frac{768000}{1024000}$, quorum differentia, h. e. summa excessus & defectus (S. 2.) est $\frac{35840}{1024000}$, cujus numerator est $= 120 d + a = 3840 + 32000$. Ergo excessus est $\frac{120}{32000}$ & defectus $\frac{1}{32}$, consequenter circulus verus $\frac{25120}{32000} - \frac{120}{32000} = \frac{25000}{32000} = \frac{25}{32}$, vel $\frac{24}{32} + \frac{1}{32} = \frac{25}{32}$. Ratio Metiana 452 : 355 multiplicata per 32, producit $= 14464 : 11360$, quæ cum defectiva $32 : 24$ prodit circulos

culos $\frac{11360}{14434}$ & $\frac{24}{32} = \frac{363520}{462848}$ & $\frac{347135}{462848}$, quorum differentia seu summa excess. & defect. est $\frac{16384}{462848}$, cujus numerator est $= 60d + a = 1920 + 14464$: unde (per §. 16.) excessus est $\frac{60}{14434}$ & defectus $\frac{7}{32}$: consequenter circulus verus $\frac{11360}{14434} - \frac{60}{14434} = \frac{11300}{14434}$, & reductus per 452 ad terminos minimos $= \frac{25}{32}$. Ratio *Archimedeæ* 14: 11 multiplicata per 32, manifestat $= 448: 352$, quæ cum defectiva prodit circulus $\frac{112}{144}$ & $\frac{24}{32} = \frac{112664}{144176}$ & $\frac{10712}{144176}$, qui ex se invicem ablatis, relinquunt summam excessus & defectus $\frac{512}{144176}$, cujus numerator est $= 2d + a = 64 + 448$. Quare excessus est $\frac{2}{448}$, consequenter circulus verus $\frac{112}{144} - \frac{2}{448} = \frac{110}{144}$ & reductus per 14 ad terminos minimos $= \frac{25}{32}$.

§. 24. Scholion. Ut usus amplissimus problematis V magis magisque patefiat, sit quadratum diametri $= 1$, ratio ejus ad circum excessiva ut 32: 26, & defectiva, ut 32: 24 $\frac{1}{2}$ = 96: 73: erunt circuli per utramque reperti $\frac{26}{32}$ & $\frac{73}{96} = \frac{2696}{3072}$ & $\frac{3336}{3072}$, quorum differentia, seu summa excessus & defectus, est $\frac{160}{3072} = d + 2a = 96 + 64$, adeoque excessus est $\frac{1}{32}$ & defectus $\frac{2}{96}$, consequenter circulus verus $\frac{26}{32} - \frac{1}{32} = \frac{25}{32}$, vel $\frac{73}{96} + \frac{2}{96} = \frac{75}{96} = \frac{25}{32}$. Sit deinde ratio excessiva 32: 25 $\frac{1}{2}$ = 160: 129, & defectiva 32: 24: erunt circuli $\frac{129}{160}$ & $\frac{24}{32} = \frac{4128}{5120}$ & $\frac{3840}{5120}$, qui ex se ablatis, relinquunt summam excessus & defectus $\frac{288}{5120}$, cujus numerator est $= 4d + a = 128 + 160$: unde excessus est $\frac{1}{128}$ & defectus $\frac{1}{32}$: consequenter circulus verus $\frac{129}{160} - \frac{1}{128} = \frac{127}{160} = \frac{25}{32}$; vel $\frac{24}{32} + \frac{1}{32} = \frac{25}{32}$. Sit denique ratio excessiva 32: 25 $\frac{1}{4}$ = 128: 103, & defectiva 32: 24 $\frac{1}{2}$ = 224: 170: erunt circuli $\frac{103}{128}$ & $\frac{170}{224} = \frac{23072}{28672}$ & $\frac{21760}{28672}$, quorum differentia prodit summam excessus & defectus $= \frac{312}{28672}$, cujus numerator est $= 3d + 5a = 672 + 640$. Ergo excessus est $\frac{1}{128}$ & defectus $\frac{1}{224}$: consequenter circulus verus $\frac{103}{128} - \frac{1}{224} = \frac{101}{128} = \frac{25}{32}$; vel $\frac{170}{224} + \frac{1}{224} = \frac{171}{224} = \frac{25}{32}$.

§. 25. Corollarium. Est ergo circulus ad quadratum diametri ut $\frac{25}{32}$: 1 = 25: 32, consequenter diameter ad peripheriam, ut 8: 25 (§. 8.).

PROBLEMA VI.

§. 26. Circulo par quadratum componere.

Resolutio. 1mo. Circulus per 2 diametros secantes se ad angulos rectos, dividatur in 4 quadrantes. 2. Utraque diameter producat 8va parte sui. 3. Ab extremitate unius diametri productæ, ad extremitatem alterius prolongatæ ducatur hypothenusa, quæ erit latus quadrati æqualis circulo.

Demonstratio. Quilibet Cathetus continet per constructionem 5 partes diametri: ergo quadrata 2 Cathetorum sunt $= 25 + 25 = 50$, consequenter quadratum hypothenusæ est etiam $= 50$. Atqui circulus, cujus diameter est 8 partium, est quoque $= 50$ (§. 8.). Ergo quadratum, cujus latus est dicta hypothenusa, est = circulo.

§. 27. Corollarium. Quod si ex circuli area data ($12\frac{1}{2}$) inveniendum sit quadratum ei æquale, extrahatur ex dimidia area ($6\frac{1}{2} = 2\frac{1}{2}$)

($6\frac{3}{4} = \frac{25}{4}$) radix quadrata ($\frac{5}{2}$); deinde jungantur 2 lineæ huic radici æquales ad angulum rectum, & ducatur hypothenusa, quæ erit latus quadrati æqualis circulo, cujus area fuit data: nam quoniam quadrata cathetorum ($\frac{25}{4} + \frac{25}{4} = \frac{50}{4} = 12\frac{1}{2}$) efficiunt aream datam circuli, & quadratum hypothenusæ inventæ est = his quadratis cathetorum; palam est, idem quoque esse = circulo, cujus area fuit data.

THEOREMA III.

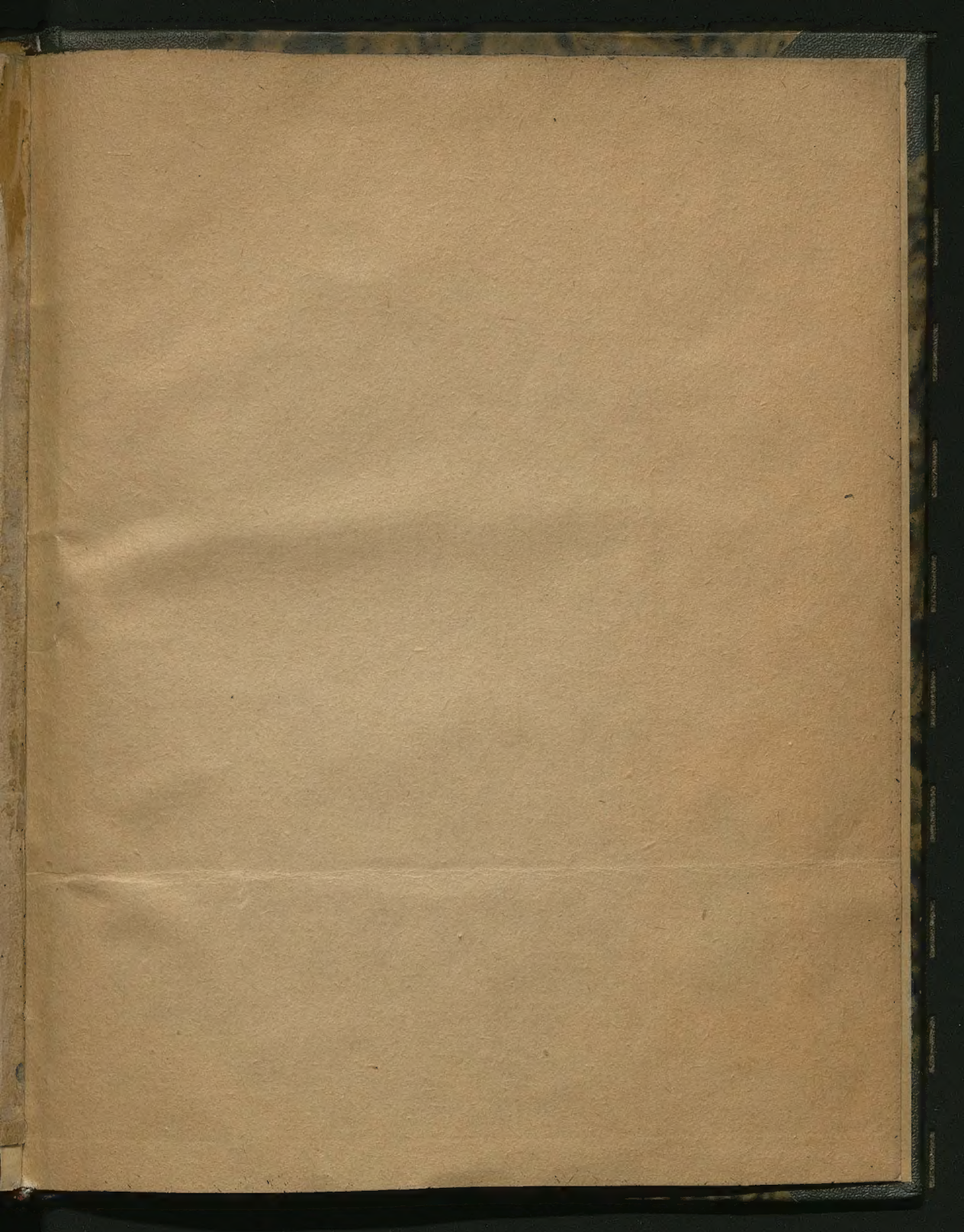
§. 28. *Sphæræ Ludolphina, Metiana & Archimæda peccant in excessu: ima* $\frac{1600}{14400}$, *2da* $\frac{90}{12544}$, *3tia* $\frac{108}{1035}$ *cubi diametri.*

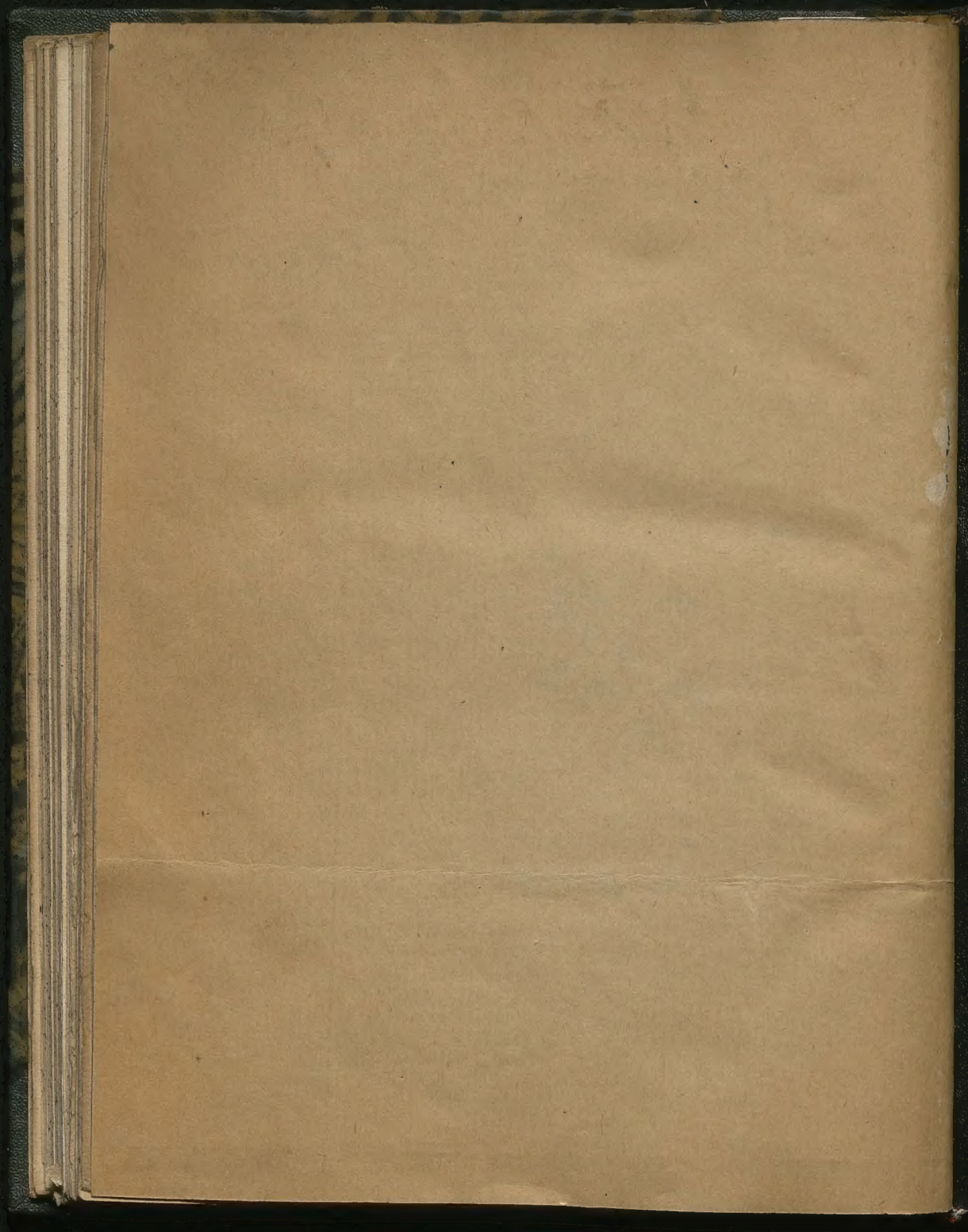
Demonstratio. Ratio *Ludolphina* cubi diametri ad spheram 300:157 multiplicata per 48, producit æqualem 14400:7536; assumtis deinde cubo diam.=1, & ratione defectiva 48:24, producit spheræ $\frac{7435}{14400}$ & $\frac{24}{48} = \frac{36128}{691200}$ & $\frac{341600}{691200}$, quarum differentia prodit summam excessus & defectus $\frac{15128}{691200}$, cujus numerator est = $36 d + a$ = 1728 + 14400: ergo excessus est $\frac{16}{14400}$ & defectus $\frac{1}{48}$ (§. 16.), consequenter sphaera vera $\frac{7500}{14400} = \frac{25}{48}$. Ratio *Metiana* 678:355 multiplicata per 48, prodit = 32544:17040, quæ cum defectiva producit spheræ $\frac{17040}{12544}$ & $\frac{24}{48} = \frac{817920}{1562112}$ & $\frac{761056}{1562112}$, quarum differentia manifestat summam excessus & defectus = $\frac{36864}{1562112}$, cujus numerator est = $90 d + a$ = 4320 + 32544: unde excessus est $\frac{90}{12544}$: consequenter sphaera vera $\frac{16750}{12544}$, & reducta per 678 ad terminos minimos = $\frac{25}{48}$. Ratio *Archimæda* 21:11 multiplicata per 48 dat = 1008:528, quæ cum defectiva prodit spheræ $\frac{1008}{4384}$ & $\frac{24}{48} = \frac{25344}{4384}$ & $\frac{24192}{4384}$, quarum differentia sistit summam excessus & defectus = $\frac{1152}{4384}$, cujus numerator est = $3 d + a$ = 144 + 1008. Ergo excessus est $\frac{108}{1035}$: consequenter sphaera vera $\frac{1025}{1035}$ & reducta per 21 ad terminos minimos = $\frac{25}{48}$.

§. 29. Scholion. Numerator summæ excessus & defectus spherarum, quarum cubus diam. = 1, inventæ per rationes 48:25 & 48:24, est = $2 d + 3 a$; repertæ per rationes 48:26 & 48:24, est = $d + 3 a$; & investigatæ per rationes 48:25 & 48:24, est = $5 d + a$: unde per (§. 16.) illico determinatur excessus & defectus, & ope utriusque sphaera vera, quæ ubique prodit = $\frac{25}{48}$.

§. 30. Corollarium. Est ergo sphaera ad cubum diametri, ut $\frac{25}{48}$: 1 = 25:48: consequenter diameter ad peripheriam, ut 8:25. (§. 8.).







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